

POWDER FACTOR IN MINING

**Understanding the Relationship between Explosives and Rock
Fragmentation**

1. INTRODUCTION

- **Powder factor** is a measure of the amount of explosive required to fragment a given volume or given quantity of rock.
- It is the relationship between how much rock is broken and how much explosive is used to break it.
- It serves as an indicator of how hard the rock is, or the cost of the explosives needed.
- The unit of powder factor is **tonne/kg**.
- For solid blasting it lies in the range of 1.5 to 2.5 tonne/kg.
- For the cut blasting it lies in the range of 4 to 5 tonne/kg.



Some pictures of a mining blast site showing explosives being prepared

2. FACTORS AFFECTING THE POWDER FACTOR

1. Rock Type and Properties:

- Different rock types require varying amounts of explosives to achieve desired fragmentation.
- Harder and denser rocks typically require higher powder factors.

2. Blast Design:

- Design parameters such as hole diameter, hole spacing, and burden influence powder factor.
- Optimal blast design ensures efficient energy transfer and fragmentation.

3. Geotechnical Conditions:

- The presence of natural joints, faults, or other geological features affects the powder factor.
- These conditions can enhance or hinder the efficiency of blasting.

2. EFFECTS OF POWDER FACTOR

1. Fragmentation:

- A higher powder factor generally results in finer fragmentation of the rock.
- Finer fragmentation enhances productivity, ease of loading, and downstream processes.

2. Vibration and Fly rock:

- Excessive powder factor can lead to increased vibration and fly rock, posing safety risks
- It may cause potential damage to nearby structures.

3. Cost:

- Powder factor directly influences the cost of blasting operations, as explosives constitute a significant expense.
- Finding an optimal powder factor helps balance fragmentation quality and cost efficiency.

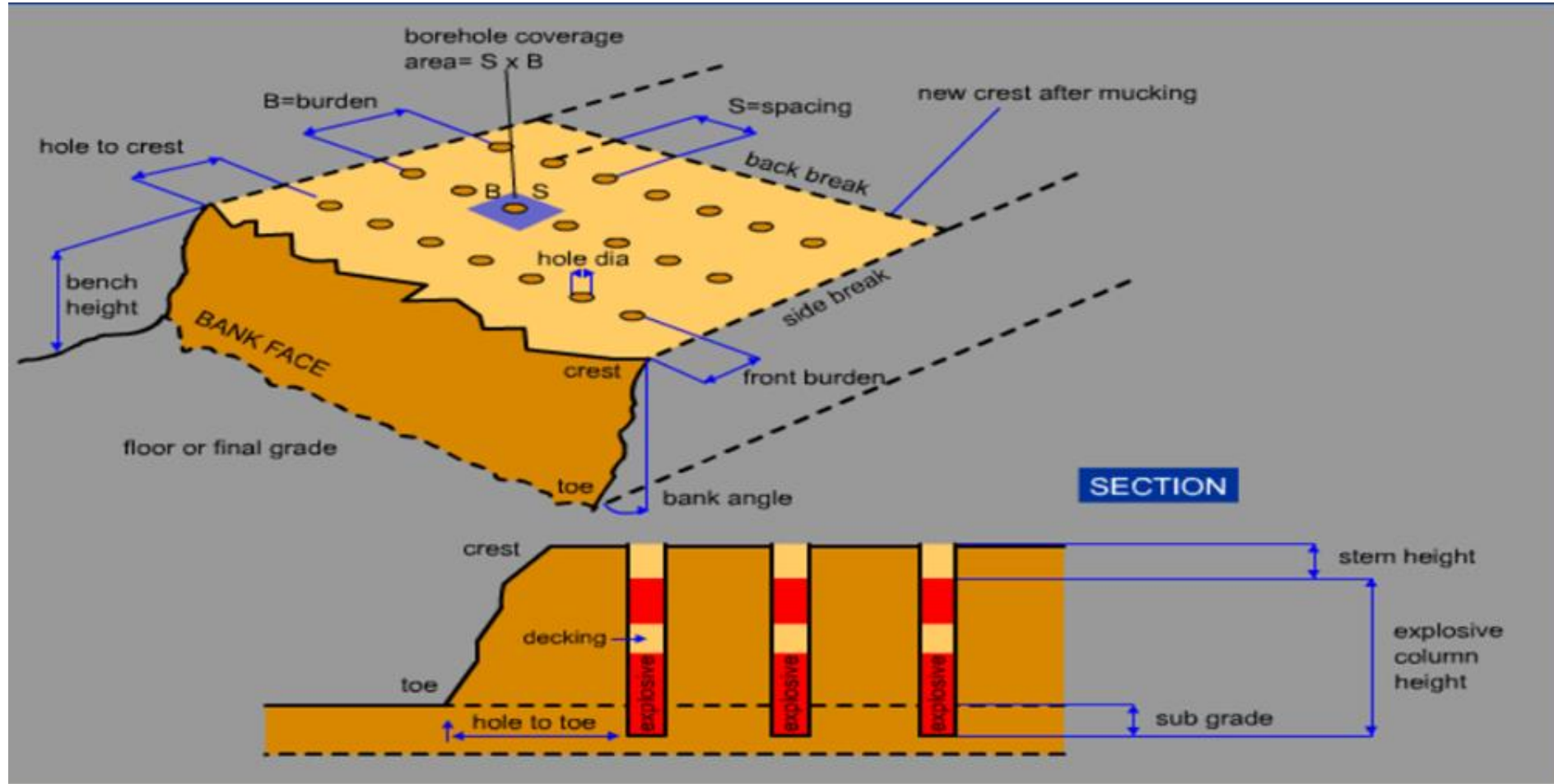


Figure showing the open-pit blast pattern design

3. POWDER FACTOR CALCULATION

$$\begin{aligned}\text{Powder Factor} &= \frac{\text{Weight of the rock produced}}{\text{Mass of explosive used}} \\ &= \frac{\text{Volume of rock} \times \text{Density of rock}}{\text{Volume of explosive} \times \text{Density of explosive}} \\ &= \frac{\text{burden} \times \text{spacing} \times \text{Bench height} \times \text{Density of rock}}{\pi \times (\text{radius of the hole})^2 \times \text{length of the hole} \times \text{Density of explosive}}\end{aligned}$$

4. NUMERICAL PROBLEM ON POWDER FACTOR

Problem:

In an overburden bench of an iron ore mine the following data were found:

Height= 10 m

Burden= 4 m

Spacing= 3 m

If the diameter of the explosive column is 150 mm and the specific gravity of explosive and that of rock are 0.9 and 2.4 respectively, the powder factor in te/kg will be

- a. 1.81 b. 2.26 c. 3.29 d. 4.53

Solution:

$$\text{Powder Factor} = \frac{\text{Weight of the rock produced (te)}}{\text{Mass of explosive used (kg)}}$$

$$= \frac{\text{Volume of rock} \times \text{Density of rock}}{\text{Volume of explosive} \times \text{Density of explosive}}$$

$$= \frac{\text{burden} \times \text{spacing} \times \text{Bench height} \times \text{Density of water} \times \text{Sp.gravity of rock}}{\pi \times (\text{radius of the hole})^2 \times \text{length of the hole} \times \text{Density of water} \times \text{Sp.gravity of explosive}}$$

$$= \frac{4 \text{ m} \times 3 \text{ m} \times 10 \text{ m} \times 2.4 \times 1000}{3.14 \times (0.075 \text{ m})^2 \times 10 \text{ m} \times 0.9 \times 1000} = 1811.75 \text{ kg/kg} = 1.81 \text{ te/kg (Ans)}$$

4. NUMERICAL PROBLEM ON POWDER FACTOR

Problem:

In an overburden bench of an iron ore mine the following data were found: = 10 m

Height = 10m

Burden = 4 m

Spacing = 3 m

Sub-grade drilling length = 1m

Collar stemming length = 3 m

If the diameter of the explosive column is 150 mm and the specific gravity of explosive and that of rock are 0.9 and 2.4 respectively, the powder factor in te/kg will be

Solution:

Given data;

Height of bench (H) = 10 m

Burden (B) = 4 m

Spacing (S) = 3 m

Sub-grade drilling length (Ls) = 1 m

Collar stemming length (Lc) = 3 m

Diameter of explosive column (d) = 150 mm = 0.15 m

S.G of explosive (λ_e) = 0.9

S.G. of rock (λ_r) = 2.4

We have,

Power Factor = weight of rock produced / Mass of explosive used

$$\begin{aligned} &= \frac{\text{Volume of rock} \times \text{density of rock}}{\text{Volume of explosive} \times \text{density of explosive}} \\ &= \frac{(H \times B \times S) \times \lambda_r}{\pi \times (d/2)^2 \times (H - L_c + L_s) \times \lambda_e} \\ &= \frac{(10 \times 4 \times 3 \times 2.4 \times 10^3)}{3.14 \times 0.15^2 / 4 \times (10 - 3 + 1) \times 0.9 \times 10^3} \\ &= 2260 \text{ kg/kg} = 2.26 \text{ te/kg} \end{aligned}$$

4. NUMERICAL PROBLEM ON POWDER FACTOR

Problem:

A blast Pattern has 13 holes, with each hole has 185gm of cartridge. Each hole has 2 cartridge. if the drilling length of hole is 1.5M.. Gallery size 4.8 mx3 m. pull (in %) = 75%. If the Density of coal 1.4 ton/m³, then Find PF (kg/ton) .

Solution:

Drilling length of the hole = 1.5m

Pull given is 75%

So, pull length is = $1.5 * 0.75 = 1.125$ m

Blast volume = $(3*4.8) * 1.125$ m = 16.2 m³

Now the total blast coal amount = $16.2 * 1.4$ te/m³ = 22.68 ton

The amount of explosive = 13 holes * 2 cartridge * 0.185 kg = 4.81 kg

Then Powder factor = $\frac{\text{The amount of explosive}}{\text{the total amount of blast coal}} = 4.81 \text{ kg} / 22.68 \text{ ton} = 0.212 \text{ kg/ton}$